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OPTIMIZATION OF COLOUR AND CLOUD STABILITY OF CARROT JUICE BY USING HYDROCOLLOIDS AND ANTIOXIDANT

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The preparation of hydrocolloids and antioxidants was employed to the carrot juice, the effect of Hydrocolloids and antioxidants including guar-gum, maltodextrin and flaxseed-gum was study and assessed for their ability to stabilize the colour and cloudiness of carrot juice. Such parameters pH, Total Soluble Solids (TSS), titratable acidity, ascorbic acid, sugars (non-reducing, reducing sugar, sugar sugar/acid ratio, total sugars, and Total Phenolic Content (TPC) was analyzed during study. All parameters were slightly decreased with the passage of time except acidity which is increased, during storage with respect to control treatment. pH, TSS, ascorbic acid, non-reducing sugar reducing sugar, total sugar, sugar/acid ratio, and TPC decreased from 4.18 to 4.15, 20.98 to 15.16^{o}Brix, 0.62 to 0.50mg/100ml, 7.04 to 6.98 %, 14 to 13.46 %, 21.04 to 20.44 %, 86.67 to 60.67and 0.13 to 0.11 mg/100ml respectively, whereas the titratable acidity increased from 0.25 to 0.26 %. Colour and cloudiness improved or stabilized by hydrocolloids (guar-gum, maltodextrin and flaxseed-gum) and antioxidant (ascorbic acid).

Keywords: Antioxidants, Colour, Cloudiness, Hydrocolloid, Stabilize,Maltodextrin

INTRODUCTION

Carrot (*Daucus Carota)* belongs to the family Apiaceae, is a plant of ancient cultivation especially in the countries bordering the Mediterranean. The wild ancestors of carrot are from Afghanistan, which remain the center of diversity of *Daucus Carota* (Alimula, 1989). Carrots production in world is 35.658 million ton and production in Pakistan is 219.399 thousand tons (FAOSTAT, 2012). It is most prevalent vegetable grown in Pakistan. Carrot occupies a prominent position owing to its dietetic and economic values. Carrot root is used as vegetable constituent in soups, stews and curries. The grated carrot used as salad while tender root as pickle (Alimulla, 1989). These not only provide energy to the body but also are good sources of vitamins and minerals.

Fresh carrot juice contains water 84%, carbohydrate 7%, protein 0.74% and dietary fiber 7% and fat 1%. Moreover, the carrot juice is also well known due to its medicinal values as it is effective against urogenital diseases. Bao and Chang (1995) reported that carrot pulp contained 4-5% protein, 8-9% reducing sugars and 5-6% minerals. Carrot juice has very short shelf life. Normally the juice of carrot is only available in winter. Due to this it is not possible to market it commercially at large scale. Shelf life of juice can be enhanced by various methods like canning, heat treatments, chemical preservatives and carbonation. But among these, carbonation is most effective way as it does not destroy the nutrient contents of the product (Elahi, 1979).

Carbonation of juice not only improves shelf life but also enhances the organoleptic properties of the product (Alimulla, 1989). Ueda (1987) conducted the studies on carbonation of carrot juice and noticed that shelf life of juice is increased up to 50 % without using any preservative. Conducted study on chemical composition of carrot juice and reported that beta-carotene contents were 5.90 mg/100 mL. (Chen *et al,*. 1995) detected the changes of carotene, color and vitamin C contents during processing of carrot juice. The effects of various processing methods on the carrot juice carotene, color and vitamin C contents were studied. The canning resulted in highest destruction of carotene. Carrot juice color changed from red to yellow during processing. The vitamin C contents decreased along with increasing temperature and storage time.

Carrots are major vegetables rich in bioactive carotenoids. Recently, the production of vegetable and fruit juices has become an emerging interest of the beverage industries all around the world because of their low caloric value and as a vital source of minerals and vitamins. Cloudy carrot juice is a naturally healthy and nutritious juicy drink. Hydrocolloids are applied mainly in fruit and vegetable juice to improve color and cloud stability because of their thickening and suspension characteristics.

The most important logic behind the frequent use of hydrocolloids in foods and as well as in cloud stability of

carrot juice is their property to change the rheological properties of food system. These properties are includes flow viscosity and texture. The changes in viscosity and texture of food system helps to alter its organoleptic characteristics so, hydrocolloids are frequently applied as major food additives to show specific purposes. Current study was designed to improve cloud as-well-as color stability of carrot juice.

MATERIAL AND METHODS

Procurement of raw materials: Fresh carrots of fresg variety were procured from local market of Faisalabad on the basis of uniformity in size, shape, optimum color and absence of physical damage, abrasion or any evidence of fungal infection. Then these fresh carrots brought to the canning hall of National Institute of Food Science and Technology.

Processing methodology: Carrots were washed with running water for 5 minutes to remove the dust and other undesired things. Blanching of freshly washed carrots were performed in 1 part of citric acid solution at 95^{o}C for 6 minute to inactivate the enzymes and soften the tissues of carrots for maximum juice extraction. Then cooling process was performed for 5 minutes at 40^{0}C to stabilize the structure of carrots. Cutting of carrots were done with knife and grinding of carrots was performed with grinder / juicer machine to extract juice. The juice was filtered with muslin cloth. Pasteurization was performed to enhance the shelf life 0f the carrot juice by killing microbes at temperature of 85^{o}C for 5 minutes**.** Immediate cooling was done to stabilize the carrot juice for further processing. Centrifugation was performed at 1200 rpm for 20 minutes to reduce the particle size at maximum level. After centrifugation I added these chemicals with these quantities as given below. Hydro colloide addition was performed with carrot juice by preparing pre solution. This pre solution further added in carrot juice at 75^{o}C for 15 minutes in form of wet mixing so that it minimized the separation. It performed to mix properly and reduce the particle size of carrot juice under pressure 0f 20 to 30 MPa for 5 minutes at 75^{o}C in homogenizer (Betriebsanlietung Beachten) of Fortuna company. Carrot juice was cooled to give the heat shock at room temperature after filing in glass bottles and bottles properly lid and sealed. Finally juice was stored at room temperature (30-35^{o}C) in glass bottles.

Physicochemical Analysis of carrot juice: pH of each sample was determined with the help of digital pH meter following the guidelines of AOAC (2007). A digital refractometer (Mod. ABBE'S refrectometer, Bellingham + Stanley, BS eclipse, UK) was used to measure Total Soluble Solids (TSS) of samples according to method given in AOAC (2000). The titratable acidity of each sample was determined by method given in AOAC (2006). Ascorbic acid contents were determined by using the method of AOAC (2006). Total sugars were determined by using the method of (AOAC, 2006**).** Reducing sugars were determined by using the method of AOAC (2006). The non-reducing sugars were calculated according to the formula. The sugar / acid ratio of carrot juice was calculated by the following formula used by Ranganna (1977).

Table 1. Chemical ingredients for carrot juice

Chemical	Quantity (g/ L of Final volume of Carrot Juice)
Sugar	100
Citric acid	1
Sodium citrate	250 ppm
Sodium benzoate	450 ppm
Ascorbic acid	1
Flexseed gum/Guargum/Maltodextrin	According to treatment plan

Table 2. Treatment plan for carrot juice

Treatments	Maltodextrin	Guargum
T_0	0	0
T_1	0	1
T_2	1	0
T_3	0.5	0.5
T_4	1	1

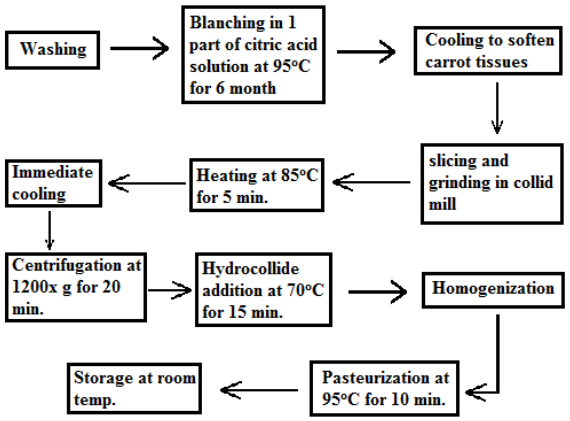

Figure 1. Line diagram of material and method

Sensory evaluation: Sensory evaluation based on color, flavor and overall acceptability was conducted using 4-point hedonic scale (4=like extremely; 1=dislike extremely) according to the procedure of Meilgaard *et al.,* (2007). Panelists of National Institute of Food Science and Technology were provided with the evaluation performa. The penalists were requested to present their views about the samples by giving score after 5days interval.

Statistical analysis: The experiment will be laid out according to completely randomized design (CRD). The data will be subjected to statistical analysis and means will be compared with the help of Least Significant Difference (LSD) Test ($P \leq 0.05$) (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

The results show that in pH there is a significant difference between treatments while storage interval and their interaction is highly significant. The pH decreased from 0 day to 60 days as the mean values are 4.86±0.19 to

Table 3. Means value of pH, Titratable acidity and TSS

pH							ACIDITY						TSS					
Treatment	Storage					Mean	Storage					Mean	Storage					Mean
	0	15	30	45	60		0	15	30	45	60		0	15	30	45	60	
T_0	4.99 ±0.15	4.11 ±0.12	4.08 ±0.12	3.97 ±0.12	3.89 ±0.12	**4.18 ±0.13**	0.19 ±0.01	0.22 ±0.01	0.26 ±0.01	0.28 ±0.01	0.31 ±0.01	**0.25 ±0.01**	22 ±0.66	21.5 ±0.65	20.9 ±0.63	20.5 ±0.62	20 ±0.60	**20.98 ±0.63**
T_1	4.89 ±0.16	4.78 ±0.15	3.75 ±0.12	3.69 ±0.12	3.67 ±0.12	**4.15 ±0.13**	0.19 ±0.01	0.21 ±0.01	0.24 ±0.01	0.27 ±0.01	0.31 ±0.01	**0.24 ±0.01**	22.5 ±0.72	21.8 ±0.70	21 ±0.67	20.5 ±0.66	20.5 ±0.66	**21.26 ±0.68**
T_2	4.87 ±0.17	4.87 ±0.17	3.79 ±0.13	3.74 ±0.13	3.72 ±0.13	**4.22 ±0.14**	0.2 ±0.01	0.23 ±0.01	0.25 ±0.01	0.27 ±0.01	0.29 ±0.01	**0.24 ±0.01**	21.9 ±0.74	20.6 ±0.70	20.2 ±0.69	20 ±0.68	19.7 ±0.67	**20.48 ±0.70**
T_3	4.87 ±0.18	4.62 ±0.17	3.8 ±0.14	3.78 ±0.14	3.72 ±0.13	**4.15 ±0.15**	0.19 ±0.01	0.23 ±0.01	0.29 ±0.01	0.29 ±0.01	0.3 ±0.01	**0.25 ±0.01**	21.6 ±0.78	20.5 ±0.74	20.5 ±0.74	20.4 ±0.73	20 ±0.72	**20.6 ±0.74**
T_4	4.69 ±0.18	4.57 ±0.17	4.27 ±0.16	4.12 ±0.16	4.02 ±0.15	**4.33 ±0.16**	0.21 ±0.01	0.24 ±0.01	0.27 ±0.01	0.28 ±0.01	0.3 ±0.01	**0.26 ±0.01**	21.2 ±0.81	13.1 ±0.50	13.5 ±0.51	13.8 ±0.52	14.2 ±0.54	**15.16 ±0.58**
Mean	**4.86 ±0.19**	**4.59 ±0.18**	**3.93 ±0.16**	**3.86 ±0.15**	**3.8 ±0.15**	**4.21 ±0.17**	**0.19 ±0.01**	**0.22 ±0.01**	**0.25 ±0.01**	**0.27 ±0.01**	**0.3 ±0.01**	**0.25 ±0.01**	**21.84 ±0.87**	**19.5 ±0.78**	**19.22 ±0.77**	**19.04 ±0.76**	**18.88 ±0.76**	**19.69 ±0.79**

Table 4. Means values of Total sugar, reducing sugar and Non-reducing sugar

Total sugar							Reducing sugar						NON reducing					
Treatment	Storage					Mean	Storage					Mean	Storage					Mean
	0	15	30	45	60		0	15	30	45	60		0	15	30	45	60	
T_0	21.49 ±0.64	21.32 ±0.64	21.3 ±0.64	20.7 ±0.62	20.4 ±0.61	**21.04 ±0.63**	7.34 ±0.22	7.26 ±0.22	6.96 ±0.21	6.84 ±0.21	**6.81 ±0.20**	7.04 ±0.21	14.15 ±0.42	14.06 ±0.42	14.34 ±0.43	13.86 ±0.42	13.59 ±0.41	**14 ±0.42**
T_1	21.46 ±0.69	21.4 ±0.68	20.3 ±0.65	19.69 ±0.63	19.54 ±0.63	**20.47 ±0.66**	7.33 ±0.23	7.3 ±0.23	6.95 ±0.22	6.95 ±0.22	**6.81 ±0.22**	7.06 ±0.23	14.13 ±0.45	14.1 ±0.45	13.35 ±0.43	12.74 ±0.41	12.73 ±0.41	**13.41 ±0.43**
T_2	21.42 ±0.73	20.42 ±0.69	19.79 ±0.67	19.62 ±0.67	19.57 ±0.67	**20.16 ±0.69**	7.38 ±0.25	7.14 ±0.24	7.06 ±0.24	6.45 ±0.22	**6.41 ±0.22**	6.87 ±0.23	14.04 ±0.48	13.98 ±0.48	13.73 ±0.47	13.17 ±0.45	13.25 ±0.45	**13.29 ±0.45**
T_3	21.27 ±0.77	21.05 ±0.76	20.54 ±0.74	20.49 ±0.74	19.96 ±0.72	**20.66 ±0.74**	7.28 ±0.26	7.08 ±0.25	6.72 ±0.24	6.54 ±0.24	**6.41 ±0.23**	6.8 ±0.24	13.99 ±0.50	13.97 ±0.50	13.82 ±0.50	13.95 ±0.50	13.55 ±0.49	**13.85 ±0.50**
T_4	21.08 ±0.80	20.68 ±0.79	20.34 ±0.77	20.12 ±0.76	20 ±0.76	**20.44 ±0.78**	7.24 ±0.28	6.98 ±0.27	6.92 ±0.26	6.9 ±0.26	**6.88 ±0.26**	6.98 ±0.27	13.84 ±0.53	13.7 ±0.52	13.42 ±0.51	13.22 ±0.50	13.12 ±0.50	**13.46 ±0.51**
Mean	**21.34 ±0.85**	**20.97 ±0.84**	**20.45 ±0.82**	**20.12 ±0.80**	**19.89 ±0.80**	**20.55 ±0.82**	**7.31 ±0.29**	**7.15 ±0.29**	**6.92 ±0.28**	**6.73 ±0.27**	**6.64 ±0.27**	**6.95 ±0.28**	**14.03 ±0.56**	**13.82 ±0.55**	**13.53 ±0.54**	**13.38 ±0.54**	**13.24 ±0.53**	**13.6 ±0.54**

Table 5. Means values of Ascorbic acid, TPC and sugar acid ratio

Ascorbic acid							Total phenolic content (TPC)						Sugar to acid ratio					
Treatment	Storage					Mean	Storage					Mean	Storage					Mean
	0	15	30	45	60		0	15	30	45	60		0	15	30	45	60	
T_0	0.62 ±0.02	0.5 ±0.02	0.37 ±0.01	0.25 ±0.01	0.12 ±0.01	**0.37 ±0.01**	0.15 ±0.01	0.14 ±0.01	0.13 ±0.01	0.13 ±0.01	0.12 ±0.01	**0.13 ±0.01**	116.3 ±3.49	98.12 ±2.94	80.71 ±2.42	73.51 ±2.21	64.78 ±1.94	**86.67 ±2.60**
T_1	0.62 ±0.02	0.62 ±0.02	0.37 ±0.01	0.12 ±0.01	0.12 ±0.01	**0.37 ±0.01**	0.15 ±0.01	0.14 ±0.01	0.13 ±0.01	0.12 ±0.01	0.12 ±0.01	**0.13 ±0.01**	118.9 ±3.80	104.2 ±3.34	87.85 ±2.81	79.17 ±2.53	66.4 ±2.12	**91.3 ±2.92**
T_2	0.75 ±0.03	0.75 ±0.03	0.5 ±0.02	0.25 ±0.01	0.25 ±0.01	**0.5 ±0.02**	0.13 ±0.01	0.13 ±0.01	0.13 ±0.01	0.12 ±0.01	0.12 ±0.01	**0.12 ±0.01**	109.9 ±3.74	89.93 ±3.06	81.13 ±2.76	74.37 ±2.53	68.21 ±2.32	**84.71 ±2.88**
T_3	0.75 ±0.03	0.75 ±0.03	0.63 ±0.02	0.53 ±0.02	0.5 ±0.02	**0.63 ±0.02**	0.13 ±0.01	0.12 ±0.01	0.11 ±0.01	0.11 ±0.01	0.11 ±0.01	**0.11 ±0.01**	114.1 ±4.11	89.49 ±3.22	76.23 ±2.74	70.63 ±2.54	66.94 ±2.41	**83.84 ±3.02**
T_4	0.75 ±0.03	0.62 ±0.02	0.62 ±0.02	0.5 ±0.02	0.5 ±0.02	**0.59 ±0.02**	0.12 ±0.01	0.11 ±0.01	0.11 ±0.01	0.11 ±0.01	0.11 ±0.01	**0.11 ±0.01**	101.4 ±3.85	54.8 ±2.08	50.2 ±1.91	49.49 ±1.88	47.52 ±1.81	**60.67 ±2.31**
Mean	**0.69 ±0.03**	**0.64 ±0.03**	**0.49 ±0.02**	**0.33 ±0.01**	**0.29 ±0.01**	**0.49 ±0.02**	**0.13 ±0.01**	**0.13 ±0.01**	**0.12 ±0.01**	**0.12 ±0.01**	**0.11 ±0.01**	**0.13 ±0.01**	**11.12 ±0.44**	**87.32 ±3.49**	**75.22 ±3.01**	**69.43 ±2.78**	**62.77 ±2.51**	**81.37 ±3.25**

Table 6. Mean values of colour, Taste and flavour

COLOUR							TASTE						FLAVOUR					
Treat	Storage					Mean	Storage					Mean	Storage					Mean
ment	0	15	30	45	60		0	15	30	45	60		0	15	30	45	60	
T_0	7.7 ±0.23	7.58 ±0.23	7.49 ±0.22	7.35 ±0.22	7.22 ±0.22	**7.46 ±0.22**	7.61 ±0.23	7.5 ±0.23	7.41 ±0.22	7.33 ±0.22	7.21 ±0.22	**7.41 ±0.22**	7.19 ±0.22	7.19 ±0.22	6.99 ±0.21	6.79 ±0.20	6.7 ±0.20	**6.97 ±0.21**
T_1	7.74 ±0.25	7.55 ±0.24	7.41 ±0.24	7.38 ±0.24	7.25 ±0.23	**7.46 ±0.24**	7.65 ±0.24	7.52 ±0.24	7.41 ±0.24	7.35 ±0.24	7.22 ±0.23	**7.43 ±0.24**	7.39 ±0.24	7.18 ±0.23	7.17 ±0.23	7.09 ±0.23	6.99 ±0.22	**7.16 ±0.23**
T_2	6.8 ±0.23	7.4 ±0.25	6.6 ±0.22	5 ±0.17	6 ±0.20	**6.36 ±0.22**	7.77 ±0.26	7.64 ±0.26	7.52 ±0.26	7.41 ±0.25	7.27 ±0.25	**7.52 ±0.26**	7.63 ±0.26	7.54 ±0.26	7.49 ±0.25	7.31 ±0.25	7.25 ±0.25	**7.42 ±0.25**
T_3	7.85 ±0.28	7.65 ±0.28	7.5 ±0.27	7.38 ±0.27	7.26 ±0.26	**7.52 ±0.27**	7.63 ±0.27	7.52 ±0.27	7.4 ±0.27	7.31 ±0.26	7.25 ±0.26	**7.42 ±0.27**	7.58 ±0.27	7.49 ±0.27	7.37 ±0.27	7.25 ±0.26	7.13 ±0.26	**7.36 ±0.26**
T_4	8 ±0.30	8.4 ±0.32	8 ±0.30	7.9 ±0.30	8.5 ±0.32	**8.16 ±0.31**	7.58 ±0.29	7.46 ±0.28	7.39 ±0.28	7.28 ±0.28	7.19 ±0.27	**7.38 ±0.28**	7.32 ±0.28	7.25 ±0.28	7.11 ±0.27	7.01 ±0.27	6.92 ±0.26	**7.12 ±0.27**
Mean	**7.61 ±0.30**	**7.71 ±0.31**	**7.4 ±0.30**	**7 ±0.28**	**7.24 ±0.29**	**7.39 ±0.30**	**7.64 ±0.31**	**7.52 ±0.30**	**7.42 ±0.30**	**7.33 ±0.29**	**7.22 ±0.29**	**7.43 ±0.30**	**7.42 ±0.30**	**7.33 ±0.29**	**7.2 ±0.29**	**7.09 ±0.28**	**6.99 ±0.28**	**7.2 ±0.29**

Table 7. Means values of mouth feel and overall acceptability

MOUTHFEEL							OVERALL					
Treatment	Storage					Mean	Storage					Mean
	0	15	30	45	60		0	15	30	45	60	
T_0	5.5 ±0.17	6 ±0.18	6.6 ±0.20	6 ±0.18	5.5 ±0.17	**5.92 ±0.18**	7.33 ±0.22	7.24 ±0.22	7.11 ±0.21	7.02 ±0.21	6.88 ±0.21	**7.11 ±0.21**
T_1	8 ±0.26	8.5 ±0.27	7.9 ±0.25	8.2 ±0.26	8 ±0.26	**8.12 ±0.26**	7.4 ±0.24	7.2 ±0.23	7 ±0.22	7 ±0.22	6.9 ±0.22	**7.1 ±0.23**
T_2	7 ±0.24	6.5 ±0.22	5.8 ±0.20	6 ±0.20	7 ±0.24	**6.46 ±0.22**	7.63 ±0.26	7.54 ±0.26	7.4 ±0.25	7.31 ±0.25	7.22 ±0.25	**7.42 ±0.25**
T_3	6.8 ±0.24	7 ±0.25	5.5 ±0.20	6 ±0.22	5.5 ±0.20	**6.06 ±0.22**	7.6 ±0.27	7.48 ±0.27	7.34 ±0.26	7.21 ±0.26	7.13 ±0.26	**7.35 ±0.26**
T_4	6 ±0.23	7 ±0.27	6.5 ±0.25	7 ±0.27	6 ±0.23	**6.5 ±0.25**	7.32 ±0.28	7.23 ±0.27	7.1 ±0.27	6.97 ±0.26	6.92 ±0.26	**7.1 ±0.27**
Mean	**6.66 ±0.27**	**7 ±0.28**	**6.36 ±0.25**	**6.64 ±0.27**	**6.4 ±0.26**	**6.61 ±0.26**	**7.45 ±0.30**	**7.33 ±0.29**	**7.19 ±0.29**	**7.1 ±0.28**	**7.01 ±0.28**	**7.21 ±0.29**

3.80±0.15 respectively. Due to the formation of acidic compounds like carbonic acid with the passage of time.

Analysis regarding TSS of carrot juice shows that there is a highly significant difference between treatments, storage interval and their interaction. TSS decreased from 0 day to 60 days as the mean values are 21.84±0.87 to 18.88±0.76^{o}Brix, respectively, during storage period. Treatment T_3 exhibited minimum change from 0 day to 60 day (21.60±0.78 to 20.0±0.72^{o}Brix).

Titratable acidity of carrot juice showed that the storage interval highly significant whereas the treatments and interaction is not significant. During storage interval, Titratable acidity increased from 0 day to 60 days as the mean values are 0.19±.0 to 0.30±.01 %, respectively. Minimum change was seen in treatment T_4 from 0 day to 60 days (0.21±.01to 0.30±.01%). This increase in acidity was possibly due to formation of acids and acidic compounds with increased storage time.

Analysis of total sugar of carrot juice shows that there is a highly significant difference between treatments and storage interval but interaction is non-significant. Total sugar decreased from 0 day to 60 days as the mean values are 21.34±0.85 to 19.89±0.80 of 0 day to 60 days, respectively during storage period. Treatment T_4 exhibited minimum change from 0 day to 60 days (21.08±0.80 to 20±0.76 %).

Reducing sugar of carrot juice at different storage intervals showed that there is a highly significant difference between treatments, storage interval and their interaction. In storage interval, reducing sugar decreased from 0 day to 60 days as the mean values are 7.31±0.29 to 6.64±o.67 % of 0 day to 60 days, respectively. Minimum change was seen in treatment T_4 from 0 day to 60 days (7.24±0.28 to 6.88± 0.26%). Sugar conversions occurred due to hydrolytic conversion of non-reducing to reducing and vice versa.

Non-reducing sugar of carrot juice showed a highly significant difference between treatments, storage interval

and their interaction. Storage period of non-reducing sugar decreased from 0 day to 60 days as the mean values are 14.03±0.56 to 13.24±0.53 %of 0 day to 60 days, respectively. Treatment T_3 showed minimum change from 0 day to 60 days (13.99±0.5to13.55±0.49%).

Results of ascorbic acid for carrot juice showed that there is a significant difference between treatments while storage interval and their interaction is highly significant. Ascorbic acid decreased from 0 day to 60 days as the mean values are 0.69±0.03 to 0.29±0.01 mg 100 g^{-1}, respectively. Treatment T_3 and T_4 exhibited minimum change from 0 day to 60 days as value of ascorbic acid is 0.75±0.03to 0.50±0.02 mg 100 g^{-1} that is minimum change.

The total phenolic content of carrot juice gives that there is a highly significant difference between treatments where storage interval was significant but their interaction is non-significant. On storage interval, TPC decreased (0.13±0.01 to 0.11±0.01) from 0 day to 60 days as the mean values respectively. Minimum change (0.12±0.01 to 0.11±0.01) was seen in treatment T_4 from 0 day to 60 days.

Analysis of Sugar acid ratio for carrot juice showed that there is a highly significant difference between treatments storage interval and their interaction. On storage interval, sugar acid ratio decreased (112.12±4.48 to 62.67±2.51) from 0 day to 60 days, respectively.

Analysis for colour of carrot juice shows that there is a highly significant difference between treatments storage interval and their interaction.The results of means of storage interval showed maximum value at 15th day 7.71±0.31 and lowest value observed at 45th day 7±0.28.

Analysis for taste of carrot juice shows that there is a highly significant difference between storage interval and non-significant treatments and their interaction. The results of means of storage interval showed maximum value at 0 day 7.64±0.31 and lowest value observed at 60th day 7.22±0.29.

Analysis for flavor of carrot juice shows that there is a highly significant difference between treatments and storage interval but their interaction is non-significance. The results of means of storage interval showed maximum value at 0 day 7.42±0.30 and lowest value observed at 60th day 6.99±0.28. Analysis for mouth feel of carrot juice shows that there is a highly significant difference between treatments storage interval and their interaction. The results of means of storage interval showed maximum value at 15th day 7±0.28 and lowest value observed at 30th day 6.36±0.27.

Analysis for over all acceptability showed that there is a highly significant difference between treatment and storage interval but their interaction is non-significance. The results of means of storage interval showed maximum value at 0 day 7.45±0.30 and lowest value observed at 60th day 7.01±0.28.

CONCLUSION

It is concluded from this research that the colour and cloudiness of carrot juice were stabilized by the use of hydrocolloids and antioxidant. Overall there were significant results observed within treatments and storage intervals. All parameters pH, ascorbic acid contents, TSS, sugars, TPC and sugar acid ratio decreased significantly within treatments and storage intervals. Only acidity increased significantly within treatments and storage intervals.

REFERENCES

Alimulla, K.S. 1989. Carotene enriched carbonated beverages. Indian Food Packers. 42: 27-29.

AOAC. 2000. Official Method of Analysis. The Association of Official Analytical Chemists.18th ed. Arlington, USA.

Askar, A., S.K. El-Samahy and A.E. Salem.1992. Production of instant guava drink powder. ConfructaStudien. 36: 154-161.

Bao, B. and K.C. Chang.1994. Carrot pulp chemical composition, color and water holding capacity as affected by blanching. J. Food Sci. 59: 1156-161.

Branco, I.G. 2001. Estudo do comportamentoreológico de misturasternárias com manga, laranja e cenoura. PhD. Thesis, State University of Campinas, Campinas, SP, Brazil.

Chang, T.S. M. Siddiq, N. K. Sinha and J. N. Cash. 1995. Commercial Pectinases and the yield and quality of Stanley plum juice. J. Food Process. Preserv.. 19: 89-101.

Chen, H.E., H. Y. Peng and B. H. Chen.1995. Stability of carotenoids and vitamin A. during storage of carrot juice. Food Chem. 57: 497-503.

Chen, B. H., H. Y. Peng and H. E. Chen.1995. Changes of carotenoids, color, and vitamin A contents during processing of carrot juice. J. Agric. Food Chem. 43:1912–1918.

Cortés, C., J. M. Esteve, A. Frígola and F. Torregrosa.2005. Changes in carotenoids including geometrical isomers and ascorbic acid content in orange–carrot juice during frozen storage. European Food Res. Tech. 221: 125-131.

Demir, N., J. Acar and K. S. Bahceci.2004. Effects of storage on quality of carrot juices produced with lactofermentation and acidification. Eur. Food Res. Tech. 218: 465-468.

Demir, N., J. Acar, K. Sarõoglu and M. Mutlu.2001. The use of commercial pectinase in fruit juice industry. Part 3: Immobilized pectinase for mash treatment. J. Food Eng. 47: 275-280.

Elahi, M. 1979. Preparation and evaluation of carbonated pomegranate drink. M.Sc. Thesis, Food Technology Department, University of Agriculture, Faisalabad.

FAOSTAT. 2012. FAO statistics division [Online]. Available at: *http://*www.faostat.org (accessed on *14th* December, 2012).

Qin, L., X. Y. Xu W.B. Zhang.2005. Effect of enzymatic hydrolysis on the yield of cloudy carrot juice and the effects of hydrocolloids on color and cloud stability during ambient storage. J. Sci. Food Agric. 85: 505-512.

Ranganna, S. 1977. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Tata McGraw-Hill Publications; New Delhi.

Steel, R.G. D., J. H. Torrie and D. A. Dicky.1997. Principles and Procedures of Statistics,A Biological Approach, 3rd ed. McGraw Hill Book Co.; New York.

Ueda, S. and K. Takizawa.1987. Carbonated beverages. European Patent Application EP-0 239 938. Food Sci. Tech. Abstr. 20:3V57, 1988).

Ullah, I. 1990. Development characterization and evaluation of water maelon, mango pear and lime juice blend. M.Sc. Thesis. Food Technology Department. University of Agriculture Faisalabad.

Zaheer, H. 1986. To study the acceptability of mixed fruit jam (apple and musk melon). M.Sc. Thesis. Food Tech. Department, University of Agriculture Faisalabad.

Zia, A. 1988. Production and characterization of fruit blends of apple kinnow and mussambi. MSc Thesis. Food Tech. Department, University of Agriculture, Faisalabad.